Northwest Pipe Company

December 18, 2015

Also sent via email

Mr. Jim Orr, R.G.
Oregon Department of Environmental Quality
Northwest Regional Office
Suite 600
700 NE Multnomah St.
Portland, OR 97232

Re: ECSI 138, Northwest Pipe Company Portland plant; Groundwater Sampling Work Plan

Dear Mr. Orr:

Northwest Pipe presents the enclosed Supplemental Groundwater Sampling Work Plan for the Southeast Area of the Northwest Pipe Company site. This work plan has been developed to address additional groundwater sampling work required by the Oregon Department of Environmental Quality (DEQ) and Region 10 of the Environmental Protection Agency (EPA) following review of Northwest Pipe Company's 2015 Remedial Investigation and Source Control Evaluation (RI/SCE) report. We appreciate DEQ's expeditious approval of the Work Plan.

If you have any questions, please do not hesitate to contact me at sheldtsheller@nwpipe.com.

Sincerely,

Stephanie Heldt-Sheller
Northwest Pipe Company
Corporate Environmental Manager

Cc: Mike Wray/Northwest Pipe Company (PDF copy)
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Supplemental Groundwater Sampling and Data Evaluation Northwest Pipe Company, Portland, Oregon ECSI #138

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DATE: December 18, 2015

1.0 Introduction

This work plan has been developed to address additional groundwater sampling work required by the Oregon Department of Environmental Quality (DEQ) and Region 10 of the Environmental Protection Agency (EPA) following review of Northwest Pipe Company's Remedial Investigation and Source Control Evaluation (RI/SCE) report (CH2M 2015). The objective of the work described in this work plan is to generate updated groundwater quality information to supplement the existing data set and help inform the source control decision for groundwater at the site.

The focus of this work is shallow groundwater at and downgradient of the Southeast Area of the Northwest Pipe Company site in Portland, Oregon (Figure 1).

1.1 Background

As part of the site characterization work for the facility, sampling work for soil and groundwater, with analysis for volatile organic compounds (VOCs), was completed from 2001 through 2007 (CH2M 2015). A total of six groundwater monitoring wells were installed and sampled in the Southeast Area of the Northwest Pipe Portland facility. The principal VOCs detected were the chlorinated solvents tetrachloroethene (PCE) and its breakdown products trichloroethene (TCE), cis-1,2-dichloeoethene (c-1,2-DCE) and vinyl chloride (VC) (note that in addition to being a breakdown product of PCE, TCE also is a commercial solvent and its presence may be attributable to use of solvents containing TCE). No additional investigation of this area had been requested by DEQ until August of 2015, in response to EPA's comments.

The Northwest Pipe Company monitoring wells are completed in an unconfined aquifer located within hydraulic fill (dredged river sediment) placed over the mudflats that formerly characterized the site vicinity during the late 1930s and early 1940s. Groundwater in the shallow fill aquifer flows generally south-southwest in the Southeast Area of the site.

As part of the characterization work, the potential for natural attenuation via microbially-mediated reductive dechlorination of the VOCs detected at the site was evaluated. Using analysis of geochemical indicators of reductive dechlorination, the site was determined to have strong evidence for anaerobic biodegradation (reductive dechlorination) of chlorinated organic compounds (CH2M 2005, EPA 1998). Using the BIOCHLOR model (EPA 2002), transport and degradation of VOCs from the Southeast Area was

predicted to yield concentrations below the levels of concern evaluated prior to discharge to the Willamette River (CH2M 2005).

However, changes in concentration and the relative preponderance of parent compounds and degradation products suggest that, VOCs also have migrated onto the Northwest Pipe facility from the offsite area to the east-northeast, based on data from monitoring well MW-05. This well (MW-05) is located close to the upgradient property line of Northwest Pipe.

1.2 Objective

The objective of this work is to provide supplemental data to help inform the source control determination for the Northwest Pipe Company Portland facility. The work consists of the following elements:

1. Demonstrate plume stability or decreasing trend in concentration and natural attenuation of VOCs in groundwater, by collecting groundwater samples in monitoring wells at and downgradient of the Southeast Area and compare them to concentrations documented in past work
2. Collect and evaluate appropriate geochemical data to further demonstrate by comparison to previous work, that site conditions are favorable for natural reductive dechlorination of VOCs
3. Confirm groundwater flow conditions on the Northwest Pipe property including flow direction, horizontal hydraulic conductivity, and horizontal hydraulic gradient, to further demonstrate plume stability and allow natural attenuation to be evaluated.
4. Evaluate the fate and transport of VOCs using the BIOCHLOR model (EPA 2002) and compare these results to previous BIOCHLOR modeling in order to assess the results against the draft preliminary remediation goals

2.0 Scope of Work

The scope of work for this data collection effort consists of aquifer testing and groundwater sampling in the Southeast Area of the site and at selected wells offsite potentially downgradient of the Northwest Pipe facility. Aquifer testing is intended to provide additional site-specific information on aquifer hydraulic characteristics to expand the understanding of the groundwater flow velocity at the site. Groundwater elevations calculated from depth to water measurements made in conjunction with groundwater sampling will confirm the hydraulic gradient (flow direction and magnitude of gradient). Groundwater sampling for VOCs will provide the agency-requested updated data to show plume stability, decrease trending, and natural attenuation. Sampling a second time for geochemical indicators of natural attenuation will provide further evidence of site conditions favorable for natural enhanced reductive dechlorination.

2.1 Well Redevelopment

The wells planned for sampling (see Section 2.3.1) will be redeveloped to confirm they are not plugged, silted in, or otherwise unable to yield representative groundwater samples. Redevelopment will consist of using a decontaminated submersible pump (such as a Grundfos Redi-Flo) and bailer to pump the wells and confirm their ability to yield water. During pumping and between pumping cycles, the pump will be raised and lowered along the well screen to promote surging and flow across different portions of the well screen. Total well depth will be measured before and after redevelopment to confirm the well screen is not silted in. If necessary and if possible, a bailer will be used to suspend and remove settled silt to the degree necessary to allow the well to be sampled. When development is complete in the opinion of the CH2M hydrogeologist, a multi-parameter meter (see Section 2.3.3) will be used to document final groundwater conditions. Well development water and any silt removed from the wells

will be stored in steel drums that will be transported to a designated staging area on the Northwest Pipe facility and managed as described in Section 2.3.5.

2.2 Aquifer Testing

The hydraulic conductivity of the shallow aquifer will be estimated based on interpretation of single-well rising head tests, commonly referred to as slug-withdrawal tests, performed on three of the six monitoring wells on the Northwest Pipe property (MW-05, MW-06, and MW-03) and the two offsite wells to be sampled as part of this work (Port of Portland monitoring wells T4S1MW-22 and T4S1MW-03s, assuming that Northwest Pipe will be able to obtain permission from the Port of Portland to access its monitoring wells). These wells are located as follows:

- Near the upgradient boundary of the Southeast Area (MW-05)
- In the central part of the Southeast Area (MW-06)
- Near the downgradient edge of the Southeast Area (MW-03)
- Near the upgradient edge of the Port of Portland Terminal 4, along the potential flow path (T4S1MW-22)
- Near the discharge point on Port Property for groundwater at Slip 1 (T4S1MW-03s)

The equipment required for the test includes a water pressure transducer and digital data logger (In-Situ Mini-Troll™ or equivalent), a manual electronic water level sounder, and a decontaminated solid slug consisting of weighted PVC pipe with closed ends. The slug will be decontaminated with detergent wash and a distilled water rinse before each use in a well and the cord used at each well will be new, to be discarded and replaced after use at each well.

The approach for performing the slug withdrawal test is as follows:

1. Decontaminate slug and water level indicator as needed.
2. Install water pressure transducer and digital data logger (In-Situ Mini-Troll™ or equivalent). Synchronize the data logger clocks and program the data logger to record the height of the water column above the pressure sensor. Measure depth to groundwater manually as the data logger is set up so that the continuous water-level measurements taken by the loggers are referenced to the appropriate datum. Manually recorded data pertaining to the test will be reported in the field notes.
3. Lower the slug into the water column and wait until the water level has stabilized to static conditions.
4. Rapidly remove the slug making sure not to disturb the transducer cable.
5. At the moment of volume removal, assigned time zero, measure and record the depth to water and the time. Supplement transducer readings with periodic manual water level measurements. Depths should be measured to the nearest 0.01 foot.
6. Continue measuring and recording depth-time measurements until the water level returns sufficiently to analyze.

Slug test data will be analyzed with the method provided by Bouwer and Rice (1976) and Bouwer (1989). Another standard method (such as the 1951 Hvorslev method [EPA 1994]) may be selected and used in addition to the Bouwer and Rice method if, in the CH2M hydrogeologist's opinion, the observed data distribution suggests it would provide useful information.

2.3 Groundwater Sampling

2.3.1 Sampling Locations

The proposed groundwater sample locations are displayed on Figure 1. The sampling program will consist of six Northwest Pipe Company monitoring wells in the Southeast Area, MW-01 through MW-06, and two Port of Portland monitoring wells (T4S1MW-22 and T4S1MW-03s), assuming that Northwest Pipe will be able to obtain permission from the Port of Portland to access its monitoring wells.

Based on a preliminary check conducted in November 2015, it appears that the Port's well logs are unavailable through the Oregon Water Resources Department well log database. CH2M will review DEQ files to locate construction and geologic logs for the two Port wells planned for sampling to confirm they are constructed and screened appropriately in the shallow fill aquifer, consistent with Northwest Pipe Company monitoring wells. If CH2M determines that the two Port wells are not constructed in a manner that would allow them to yield representative groundwater samples from the shallow fill aquifer, CH2M will inform DEQ of this finding.

2.3.2 Sampling Events and Proposed Analysis

CH2M recommends two sampling events to reflect the wet/dry climatic conditions that occur in the Portland area: one sample in the wet season associated with frequent measurable precipitation (typically November through May) and one sample in the dry season associated with little to no measurable precipitation (typically July through September). Some guidance documents recommend four quarterly samples to characterize possible seasonal effects on groundwater quality results; however, such recommendations would be most relevant for sites located in areas where climatic conditions reflect a 4-season hydrologic system. This is not the case in the Portland area, with its pronounced 2-part wet/dry climatic and hydrologic conditions. Sampling will occur no sooner than 2 weeks after redevelopment and slug testing, to reduce the potential that those activities could influence the laboratory analytical results.

The primary objective of the sampling is to characterize current VOC concentrations in groundwater. Consequently, sample sets described in this work plan will be analyzed for VOCs. In addition, the initial sample set will be analyzed for the following selected geochemical indicators, which are commonly used to evaluate the potential for natural attenuation (EPA 1998), to supplement the measurements made in 2005:

- Dissolved oxygen (DO) – field measurement
- Oxidation-reduction potential (ORP) – field measurement
- Temperature – field measurement
- pH – field measurement
- Dissolved iron and manganese
- Chloride
- Sulfate
- Nitrate
- Total organic carbon

These constituents represent the overall chemistry of the aquifer, which typically varies over a narrow range. Concentrations of constituents that are increased under conditions favorable to reductive dechlorination would be well above reporting limits, minimizing sensitivity to small changes that parameters experience at very low concentrations near reporting limits. Consequently, and in light of the prior geochemical characterization completed in 2005, sampling the eight wells a second time for geochemical parameters will be sufficient to characterize aquifer conditions.

2.3.3 Sampling Methods

Groundwater samples will be collected using low-flow, also known as low-stress, sampling techniques. The following sections describe the procedures, documentation, and sample handling procedures to be followed during this work.

Pre-sampling groundwater level measurements

Prior to sampling, the depth to groundwater will be measured in each of the wells to be sampled prior to initiating purging and sampling activities as well as other accessible site wells on the Port's property. An electronic water level indicator with an audible alarm and a cable marked in 0.01-foot increments will be used for the measurements. Before use, and between wells, the wetted portion of the water level indicator tip will be decontaminated using a distilled water rinse. If the wells are sealed with an airtight cap, 20 to 30 minutes will be provided to allow pressure to equilibrate after the cap is released and before water levels are measured. Measurements will be repeated until consecutive readings are within 0.01 foot.

Well purging and sampling

Purging and sampling will be conducted using a peristaltic pump with new disposable polyethylene discharge tubing and new disposable silicone head tubing at each well (EPA 1998). The peristaltic pump will be powered by either a car battery or generator. Should a generator be used, it will be located downwind of sampling activities at sufficient distance and gloves will be changed following any contact with the generator to prevent sample contamination. To further reduce the potential for cross-contamination, wells will be purged and sampled in order of expected lowest to highest concentrations of VOCs. For the first sampling event, the recommended sequence will be T4S1MW-03s, T4S1MW-22, MW-03, MW-01, MW-04, MW-06, and MW-05. The well sequence for the second sampling event will be determined using laboratory results of VOC concentrations from the first sampling event.

Prior to beginning purging at a well, the static, pre-purging water level will be measured with a water level indicator and recorded. The pump intake will be set within the middle of the screened interval and the drawdown will be kept as low as reasonably possible (target of 0.33 foot) using flow rates in the range of 0.1 to 0.3 liter per minute. Purge water will be directed into 5-gallon buckets with fitted lids, which will be emptied into one or more 55-gallon labeled, steel drums with lids. The initial measurements of pH, specific conductance, dissolved oxygen, turbidity, and temperature of the purge water will be observed and recorded in the field logbook and/or sampling log for the well. Subsequent readings will be noted after removal of approximately 1 well casing volume, and then at a frequency of approximately every 5 minutes until water quality parameters have stabilized; defined as three successive measurements within the target criteria listed in Table 1.

Water quality parameters will be measured inline using a YSI 556 multiparameter water quality meter or similar instrument with a flow-through cell to monitor pH, oxidation-reduction potential (ORP), specific conductance, dissolved oxygen (DO), and temperature. A separate turbidity meter, HACH 2100Q or similar instrument, will be used to record turbidity readings from the effluent of the flow-through cell. Field meters will be calibrated following the manufacturer's specifications at the start of each day of sampling. The results of this calibration will be noted in the field notebook.

Table 1. Stabilization Criteria for Water Quality Parameters
Supplemental Groundwater Sampling
Northwest Pipe Company Portland Plant

Parameter	Target Stabilization Criteria
pH	+/- 0.1 pH units
Specific Conductance	+/- 3% µS/cm
ORP	+/- 10 millivolts
Turbidity	+/- 10% NTUs (when turbidity is greater than 10 NTUs)
DO	+/- 0.3 mg/L

Notes:

ORP = oxidation-reduction potential
DO = dissolved oxygen
µS/cm = microSiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity units
mg/L = milligrams per liter

After the field parameters have stabilized during purging, the in-line flow cell will be disconnected and the well will be sampled. The elapsed time between stabilization of field parameters and the beginning of sampling will be as short as reasonably possible to minimize potential changes in water quality after field parameter values have been documented. Samples will be placed in laboratory-provided containers previously prepared with the appropriate preservative, if necessary, by the analytical laboratory. Field personnel will replace nitrile gloves with new pair prior to sample collection and change gloves between sample locations to reduce the potential for cross-contamination. The pumping rate used for sample collection will be approximately 0.1 liter per minute or less.

For the initial samples, when samples will be analyzed for both VOCs and geochemical parameters, VOC samples will be collected first. VOC vials will be filled in such a way as to minimize the volatilization of VOCs and dilution or loss of laboratory-provided sample preservative. The pumped water will be directed to run down the inside wall of the sample bottle to minimize splashing, bottles will not be overfilled, and no air bubbles or headspace will remain in vials upon completion of filling.

Samples for iron and manganese will be field-filtered using a new, disposable 0.45-micron in-line filter to remove artificial turbidity, if any, that could bias sample results. The other sample containers listed in Table 2 will be filled in the Sample handling will follow the procedures listed in the section below.

Sample Handling and Quality Assurance

The selected laboratory will provide the required sample containers. The analytical laboratory will add preservatives, as needed, prior to shipping the sample containers to the field. The laboratory, upon receipt of the samples, will verify the adequacy of preservation and will add additional preservative, if necessary.

Trip blanks will be analyzed for VOCs and included at a rate of 1 per sample cooler (that is, 1 per event). Because disposable sample equipment will be used, no equipment blank is necessary. One blind sample duplicate (labeled MW-100) will be analyzed for each sample event.

Sample preservation efforts will commence at the time of sample collection and will continue until analyses are performed. After filling, sample containers will be placed promptly in an insulated cooler with ice to maintain sample temperature at or below 4 degrees Celsius (°C). The ice will be double

bagged in plastic storage bags. Coolers will be kept out of direct sunlight. The temperature of the samples will be documented upon receipt at the laboratory.

A chain of custody (COC) form will be completed for each sampling event. The original copy will be provided to the laboratory with the sample shipping cooler, and a copy will be retained in the field documentation files. The coolers containing the samples will be sealed with a custody seal any time the coolers are not in an individual's possession or view before shipping. The custody seals will be signed and dated by a sampling team member.

Samples will be hand delivered or shipped by overnight express carrier for delivery to the analytical laboratory. Samples will be shipped for laboratory receipt and analyses within specific holding times.

Field Documentation

Standard field information [typically weather conditions, personnel onsite, equipment calibration, sample information and location, and field observations], any deviations from the work plan, and the reason for deviations will be recorded daily in a field logbook. In addition, general observations of samples and field parameter measurements will be documented in the field logbook and/or the groundwater sampling worksheets.

Sample labels will be filled out using waterproof ink. At a minimum, each label will contain the following information:

- Sample identification code (i.e., MW06-122015-0)
  - Well ID and sample date (MMDDYY)
- Date and time of sample collection
- Sampler's signature or initials

2.3.4 Laboratory Analysis

Samples will be submitted to the Applied Sciences Laboratory for analysis:

Applied Sciences Laboratory (ASL)
1100 NE Circle Blvd, Suite 300
Corvallis, OR 97330-3538
(541) 768-3120

The laboratory will be requested to provide results using standard turnaround time; generally 2 to 4 weeks depending on laboratory sample volume. The sample containers, preservative requirements, and maximum holding times for individual analyses are shown in Table 2. ASL is certified under the National Environmental Laboratory Accreditation Program (NELAP) as well as the Oregon Environmental Laboratory Accreditation Program (ORELAP).

Table 2. Sample Containers, Holding Times, and Analytical Methods
Supplemental Groundwater Sampling
Northwest Pipe Company Portland Plant

Analysis	Method	Container Size	Container Type	Preservative	Holding Time	Reporting Limit
VOCs	SW8260C	(3) 40 mL	Glass VOA vials	HCl	14 days	0.5 µg/L
PCE[1]	SW8260 SIM	(3) 40 mL	Glass VOA vials	HCl	14 days	0.1 µg/L
Fe *	E200.7	250 mL – field filtered	HDPE	HNO_3	180 days	100 µg/L
Mn*						10 µg/L
Cl	E300.0	(1) 250 mL	HDPE	None, 4°C	28 days	200 µg/L
SO_4	E300.0				28 days	200 µg/L

Table 2. Sample Containers, Holding Times, and Analytical Methods
Supplemental Groundwater Sampling
Northwest Pipe Company Portland Plant

Analysis	Method	Container Size	Container Type	Preservative	Holding Time	Reporting Limit
NO_3	E353.2				48 hours	10 µg/L
TOC	SM5310	(1) 250 mL	HDPE	H_2SO_4	28 days	500 µg/L

Notes:
[1] To achieve lower reporting limits, PCE will be analyzed separately with method SW8260 SIM.
* dissolved metals – iron (Fe), manganese (Mn)
°C = degrees Celsius.
µg/L = microgram per liter
mL = milliliter
HDPE = high-density polyethylene

2.3.5 Investigation-Derived Waste Management

Purge water and any suspended silt from well redevelopment, sampling activities, and equipment decontamination water will be contained, labeled, and temporarily stored in a designated location at the Northwest Pipe facility. It is anticipated that up to two 55-gallon drums will be needed to store purge water generated during the work described in this work plan with up to one additional drum per well to contain well redevelopment water. Drums will be labeled and covered with lids. At the conclusion of the sampling program, the drums will be disposed of by Northwest Pipe through a commercial wastewater treatment service as part of its routine waste management procedures. Tubing, gloves, and other solid waste will be managed by Northwest Pipe as solid waste along with other site solid waste from the site.

2.3.6 Health and Safety

Sampling by CH2M staff will be conducted according to the site health and safety plan consistent with 29 CFR 1910, which calls for modified Level D personal protective equipment to be worn during sampling activities (hard hat, safety glasses with side shields, steel-toed boots, and safety vest).

3.0 Data Analysis and Reporting

Following the completion of the aquifer testing and the receipt of laboratory data, the following analyses will be performed:

- Analyze aquifer test data using the Bouwer and Rice method, supplemented with another standard method depending on data distribution, to document aquifer hydraulic conductivity.
- Generate groundwater contour maps for each measurement event to document flow direction and magnitude of hydraulic gradient.
- Tabulate VOC data and geochemical data.
- Update time-concentration plots for PCE, trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC).
- Evaluate data with the BIOCHLOR spreadsheet model, a screening model that simulates the remediation by natural attenuation of dissolved solvents, including a sensitivity analysis of selected input parameters and a comparison of the output results with Portland Harbor draft PRGs.

Data and results of the analysis will be provided to DEQ and EPA in the form of a technical memorandum that will subsequently be incorporated into a final RI/SCE report (either by attaching or by incorporating into the text itself).

As requested by DEQ, CH2M will provide preliminary result updates via email after results are received from each sample event and validated by data quality review.

4.0 References

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